

# Volatility Monitor

3<sup>rd</sup> Quarter 2012

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Volatility is one of several key inputs into mathematical option on futures pricing models along with market price, strike price, term until expiration and short-term interest rates. While market price movements exert the most obvious impact upon the option premium, volatility remains a very important factor. So much so that many traders strive to predict future levels of volatility and engage in so-called “volatility plays” as a result.

Traders may “buy volatility” generally by buying options; or, “sell volatility” by selling options, often in concert with the placement of a hedge in the futures market structured by reference to the net delta associated with the option positions.

This report represents an update of volatility through the 2<sup>nd</sup> quarter 2012 in a variety of what we might consider to be CME Group “flagship” products.

### Historic Volatility

There are many ways to measure volatility in any particular option market. “Historic volatility” is a reference to the annualized standard deviation of day-to-day price movements in the market that underlies the option of interest. This figure is generally calculated over a particular prior time period, e.g., 30 days, 60 days, 90 days, etc.

Note that over the past month (roughly 30 calendar days), there are generally 21 trading days; 42 trading days over the past 60 calendar days, etc. An annualized historic volatility (HV) is generally calculated using the following formula, assuming that there are 252 trading days in a calendar year.

$$HV = \sqrt{252} \cdot \sqrt{\left(\frac{1}{n}\right) \sum_{i=1}^n (X_i - \bar{X})^2}$$

$$X_{i+1} = \ln (P_{i+1}/P_i)$$

Where:

*P* = Price of underlying market

*N* = Number of business days in period, generally 20 for 1 month; 40 for 2 months, etc.

### Implied Volatility

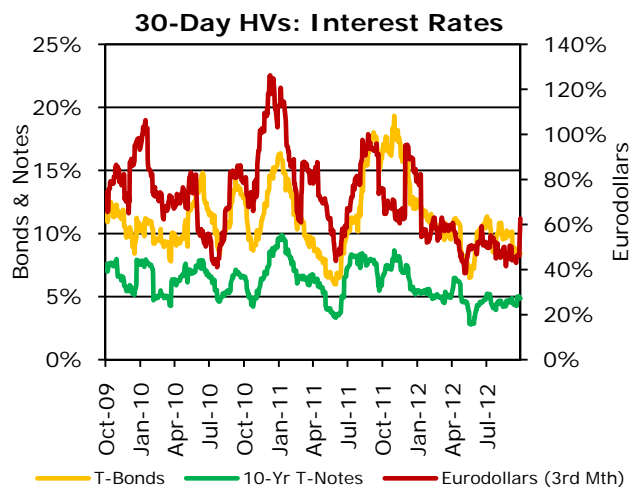
Implied volatility (IV) may be thought of as the volatility that is implicit in the premium associated with any specific option. You can use any number of available mathematical option pricing models to derive the (theoretical) option on futures premium as a function of the current market price (P), strike price (S), volatility (V), term until option expiration (t) and short-term rates (r).

$$Premium = f(P, S, V, t, r)$$

But there may be no need to calculate the theoretical option premium when the premium may be observed in a competitively traded marketplace. An implied volatility (IV) is derived by solving the option pricing formula to find volatility as a function of market price, strike price, term and short-term rates.

$$IV = f(Premium, P, S, t, r)$$

Unfortunately, solving a mathematical option pricing model, such as the Black formula (1976) for options on futures, results in an unsolvable polynomial. However, it is possible to utilize a computer assisted iterative methodology quickly to converge to a solution.

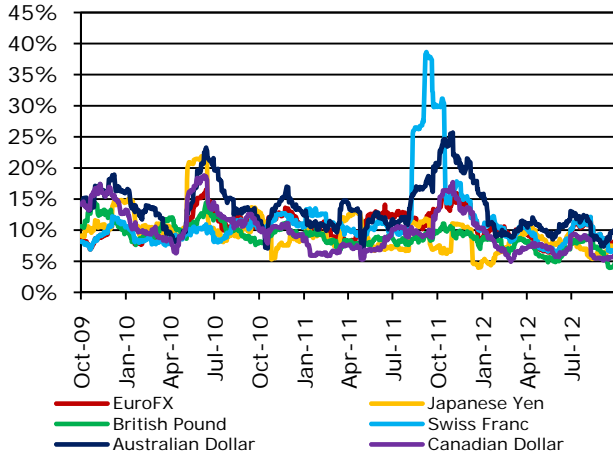


### Mean Reversion

While volatilities may vary considerably over time in the context of any given market, they do tend to hover towards a long-term mean or characteristic level. Thus, option traders often find it useful to

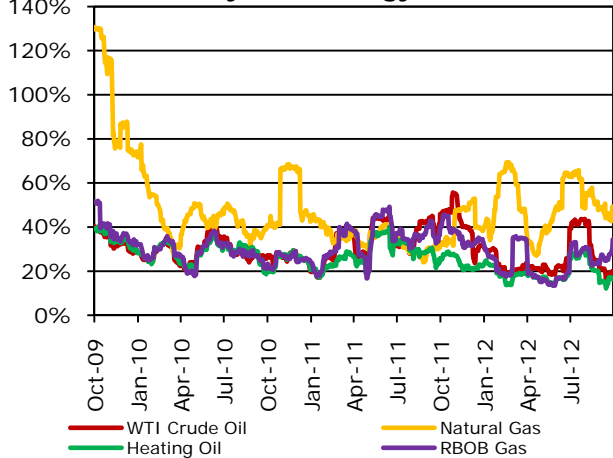
study those average levels in the hopes of identifying mispriced options.

### 30-Day HVs: Currencies



One popular technique is to study the average (median) volatility observed in the marketplace over the past year or past three (3) years. The tables found at the conclusion of this document provide the median, maximum and minimum levels of 30-day historic volatilities in a sampling of some of the most actively traded CME Group markets including the interest rate, stock index, currency, energy, grain, precious metals and livestock complexes.

### 30-Day HVs: Energy Products

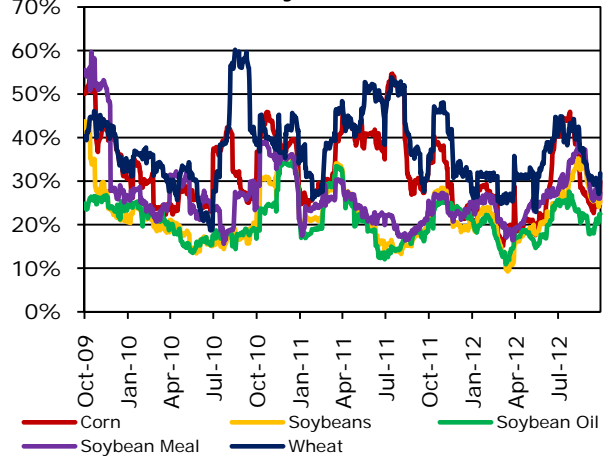


We further include graphics of 30-day historic volatilities over the past several years. Generally, we examine volatility in the lead or nearby month, with the exception of Eurodollar futures where the 3<sup>rd</sup> month historically has frequently represented the most actively traded contract.

### Comparing HV and IV

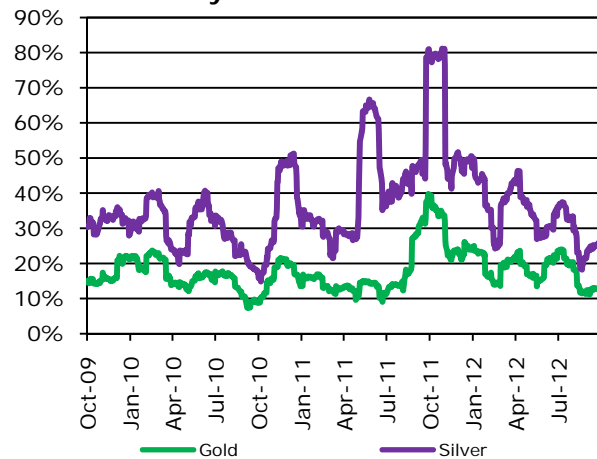
We might compare those levels to current implied volatilities in actively traded options to get a feel for whether options are reasonably priced relative to historic averages.

### 30-Day HVs: Grains



*E.g.,* assume that a (hypothetical) call option exercisable for corn futures had an implied volatility of 29.00%. The 1-year median observation for 30-day HVs in nearby corn futures is at 25.84%. Thus, this option displays volatility that is somewhat higher than observed volatility over the past year, falling somewhere between the 60<sup>th</sup> and 75<sup>th</sup> percentiles.

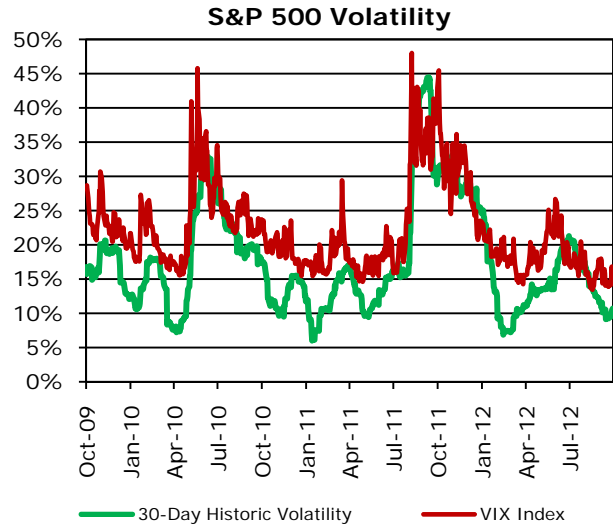
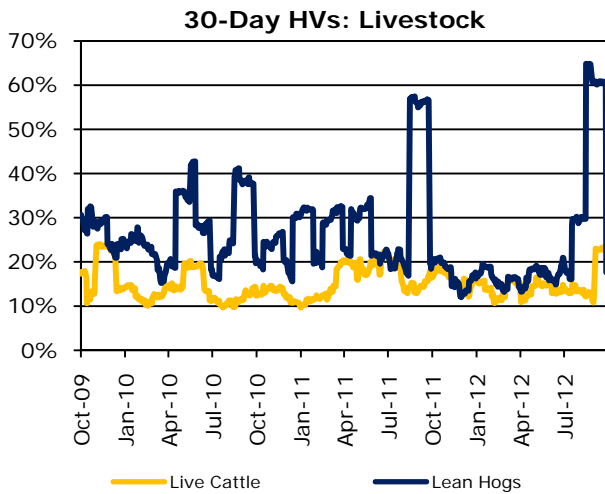
### 30-Day HVs: Precious Metals



The 3-year median observation for 30-day HVs is at 30.55%. The IV of 29.00% is below the 3-year median and between the 40<sup>th</sup> and 50<sup>th</sup> percentiles. Viewed by this metric, the IV might just be a bit low by historic standards.

*E.g.*, a hypothetical at-the-money call exercisable for S&P 500 futures displayed an implied volatility of 16.00%. This is above the 1-year median of 15.47% and between the 50<sup>th</sup> and 60<sup>th</sup> percentiles. It is also above the 3-year median of 15.71%, falling between the 50<sup>th</sup> and 60<sup>th</sup> percentiles.

up and down in parallel, the 30-day HV tends to be a bit over-reactive relative to the VIX. *I.e.*, traders' aggregate expectations regarding volatility in the S&P 500 tend to be a bit more stable than the 30-day historic average.



### Implied Volatility Index

Traders often reference the IV associated with at- or near-the-money calls or puts as standard reference for where traders (implicitly) believe volatility will be between the current point in time and option expiration. As such, IVs are “forward-looking” while HVs may be regarded as “backwards-looking.”

But the IV for any particular option may be a bit different than the IV for another option even where the two options are based upon the same underlying instrument with the same expiration date. That may be explained by the fact that traders may impute more or less value to options that are in- or out-of-the-money.

The CBOE S&P 500 VIX Index is a popular measure referencing IVs. It represents an average IV sampled over a variety of liquid CBOE S&P 500 options. While the VIX and 30-day HVs typically run

### Concluding Notes

Finally, please be aware that volatilities associated with Eurodollar futures are calculated based on the implied yield of the instrument where yield = 100 less the quoted price. Because yields have fallen to historical lows, the base of the volatility calculation becomes very low and tends to inflate the calculated volatility.

We do not, of course, purport to offer specific trading advice. Rather, our purpose here is to provide an enhanced understanding of volatility as one of the prime drivers of option premiums and to illustrate a simple but popular way of regarding volatility.

**30-Day Historical Volatilities over 1-Year Window**  
(7/1/11 to 6/30/12)

	Percentiles								
	Max	90%	75%	60%	Median	40%	25%	10%	Min
<b>INTEREST RATES</b>									
<b>Eurodollar (3<sup>rd</sup> Month)</b>	95.43%	78.94%	63.12%	58.30%	<b>54.83%</b>	52.30%	49.70%	45.14%	38.46%
<b>T-Bonds</b>	19.32%	16.77%	12.32%	10.90%	<b>10.47%</b>	10.13%	9.64%	8.42%	6.49%
<b>10-Yr T-Notes</b>	8.66%	7.40%	5.81%	5.24%	<b>5.02%</b>	4.86%	4.58%	4.25%	2.79%
<b>STOCK INDEXES</b>									
<b>S&amp;P 500</b>	33.07%	30.21%	24.75%	17.58%	<b>15.47%</b>	13.55%	11.65%	9.34%	6.87%
<b>Nasdaq-100</b>	31.20%	29.13%	23.63%	20.37%	<b>18.75%</b>	16.20%	12.21%	10.43%	7.03%
<b>CURRENCIES</b>									
<b>EuroFX</b>	15.94%	14.42%	11.17%	10.16%	<b>9.63%</b>	9.11%	8.41%	6.91%	6.28%
<b>Japanese Yen</b>	11.08%	10.29%	8.85%	8.09%	<b>7.48%</b>	7.08%	6.32%	5.09%	3.98%
<b>British Pound</b>	11.06%	9.78%	8.70%	8.38%	<b>8.06%</b>	7.30%	6.67%	5.45%	3.96%
<b>Swiss Franc</b>	31.15%	15.68%	11.69%	10.61%	<b>10.30%</b>	9.37%	8.32%	6.83%	6.31%
<b>Australian \$</b>	25.69%	21.76%	15.47%	11.43%	<b>10.99%</b>	10.54%	9.61%	8.89%	7.38%
<b>Canadian \$</b>	17.70%	15.19%	10.21%	8.51%	<b>7.45%</b>	7.03%	6.33%	5.57%	4.92%
<b>ENERGY</b>									
<b>WTI Crude Oil</b>	55.63%	46.03%	40.03%	29.29%	<b>24.47%</b>	22.19%	21.09%	19.23%	13.17%
<b>Natural Gas</b>	69.44%	64.41%	55.22%	49.47%	<b>48.03%</b>	46.24%	39.68%	32.99%	27.02%
<b>Heating Oil</b>	29.00%	27.58%	23.32%	21.13%	<b>19.08%</b>	18.51%	16.98%	15.07%	12.17%
<b>RBOB Gas</b>	45.63%	37.39%	33.65%	30.20%	<b>27.30%</b>	24.53%	18.76%	16.43%	13.46%
<b>GRAINS</b>									
<b>Corn</b>	45.89%	42.36%	34.35%	27.65%	<b>25.84%</b>	23.75%	21.09%	18.75%	15.16%
<b>Soybeans</b>	35.21%	30.80%	26.29%	23.89%	<b>22.41%</b>	20.46%	19.09%	16.12%	9.28%
<b>Soybean Oil</b>	27.61%	25.07%	23.56%	22.07%	<b>20.92%</b>	19.91%	17.78%	15.17%	10.90%
<b>Soybean Meal</b>	38.87%	34.26%	27.25%	26.28%	<b>25.33%</b>	24.62%	22.67%	19.90%	16.44%
<b>Wheat</b>	48.06%	44.60%	39.39%	34.26%	<b>32.01%</b>	31.47%	30.68%	26.84%	22.95%
<b>PRECIOUS METALS</b>									
<b>Gold</b>	39.32%	25.56%	23.28%	21.36%	<b>20.53%</b>	19.49%	16.43%	12.86%	11.16%
<b>Silver</b>	81.12%	51.19%	45.17%	39.21%	<b>36.82%</b>	33.99%	29.30%	24.83%	18.21%
<b>LIVESTOCK</b>									
<b>Live Cattle</b>	23.60%	18.08%	15.84%	15.09%	<b>14.61%</b>	13.99%	13.06%	12.12%	10.75%
<b>Lean Hogs</b>	64.84%	60.40%	19.98%	18.44%	<b>17.64%</b>	16.74%	15.81%	14.03%	12.04%

**30-Day Historical Volatilities over 3-Year Window**  
(7/1/09 to 6/30/12)

Percentiles									
	Max	90%	75%	60%	Median	40%	25%	10%	Min
<b>INTEREST RATES</b>									
<b>Eurodollar (3<sup>rd</sup> Month)</b>	126.18%	94.95%	83.17%	74.74%	<b>71.05%</b>	66.23%	56.11%	48.46%	38.46%
<b>T-Bonds</b>	19.32%	15.77%	12.43%	11.31%	<b>10.83%</b>	10.23%	9.59%	8.46%	5.98%
<b>10-Yr T-Notes</b>	9.86%	7.95%	7.28%	6.59%	<b>6.25%</b>	5.53%	5.01%	4.42%	2.79%
<b>STOCK INDEXES</b>									
<b>S&amp;P 500</b>	44.46%	30.08%	20.09%	17.30%	<b>15.71%</b>	14.42%	12.19%	9.65%	6.01%
<b>Nasdaq-100</b>	43.50%	29.19%	20.99%	18.59%	<b>17.22%</b>	15.80%	13.43%	10.67%	7.03%
<b>CURRENCIES</b>									
<b>EuroFX</b>	16.51%	13.43%	12.01%	10.88%	<b>10.43%</b>	9.70%	8.82%	8.09%	6.28%
<b>Japanese Yen</b>	21.88%	12.87%	10.76%	9.88%	<b>9.14%</b>	8.58%	7.42%	6.48%	3.98%
<b>British Pound</b>	14.50%	11.64%	10.10%	9.32%	<b>8.82%</b>	8.52%	8.01%	6.94%	3.96%
<b>Swiss Franc</b>	38.62%	14.64%	11.41%	10.66%	<b>10.31%</b>	9.81%	8.85%	7.99%	6.31%
<b>Australian \$</b>	25.69%	19.51%	15.61%	13.47%	<b>12.89%</b>	11.89%	10.84%	9.30%	6.90%
<b>Canadian \$</b>	18.78%	15.50%	12.25%	10.24%	<b>9.38%</b>	8.79%	7.24%	6.12%	4.92%
<b>ENERGY</b>									
<b>WTI Crude Oil</b>	55.63%	42.70%	37.05%	31.64%	<b>29.07%</b>	27.11%	24.60%	20.74%	13.17%
<b>Natural Gas</b>	130.66%	74.18%	54.88%	47.62%	<b>43.37%</b>	40.57%	36.23%	31.60%	24.05%
<b>Heating Oil</b>	40.33%	34.55%	30.65%	28.11%	<b>26.65%</b>	24.47%	21.05%	17.36%	12.17%
<b>RBOB Gas</b>	51.83%	41.21%	35.70%	32.55%	<b>30.18%</b>	27.86%	25.31%	18.91%	13.46%
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<b>Soybeans</b>	60.57%	33.38%	27.13%	22.78%	<b>21.34%</b>	19.83%	17.83%	15.38%	9.28%
<b>Soybean Oil</b>	37.75%	26.66%	24.37%	22.32%	<b>20.61%</b>	18.84%	17.63%	15.13%	10.90%
<b>Soybean Meal</b>	84.08%	37.54%	29.62%	26.63%	<b>25.68%</b>	24.38%	22.54%	19.37%	15.63%
<b>Wheat</b>	60.15%	48.69%	42.85%	39.30%	<b>36.89%</b>	34.25%	31.28%	27.66%	18.72%
<b>PRECIOUS METALS</b>									
<b>Gold</b>	39.76%	23.59%	21.18%	17.24%	<b>16.25%</b>	15.37%	13.93%	12.17%	7.37%
<b>Silver</b>	81.12%	49.47%	42.52%	35.98%	<b>33.31%</b>	32.18%	28.33%	23.17%	14.84%
<b>LIVESTOCK</b>									
<b>Live Cattle</b>	23.98%	20.10%	17.14%	14.84%	<b>14.20%</b>	13.63%	12.55%	11.25%	9.66%
<b>Lean Hogs</b>	64.84%	42.67%	31.04%	26.47%	<b>22.96%</b>	20.95%	18.52%	16.01%	12.04%

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